

# The Development of Neuro-Surgery

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*Address at the Opening of the Winter Session 1946-47,  
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A LITTLE over 154 years ago a small dispensary, dedicated to the care of the sick poor, was opened in Smithfield. From this modest, but most worthy, beginning, our present noble heritage, the Royal Victoria Hospital, has been evolved by the zeal and self-sacrifice of an illustrious band of workers. Our meeting together here this morning marks the one hundred and nineteenth anniversary of the devotion of this institution to the teaching of medicine. It has long been customary at the opening ceremony of each winter session to extend a hearty welcome to the students of all years, but more especially to those who are about to walk the Hospital for the first time. On behalf of the medical staff, this I most cordially do, and I am persuaded that in the capacity in which I stand to-day I have the honour of addressing many who, in fullness of time, will look back on a life enriched by good service to their fellow-men, or, perhaps, even one who, by his genius, may introduce a new principle in the treatment of disease which will make humanity his debtor for all time.

We record with deep regret the death during the past year of two members of our consulting staff, Dr. Victor G. L. Fielden and Mr. Henry Hanna. Dr. Fielden, after many years of devoted service as senior anaesthetist to the Hospital, retired from the honorary visiting staff in 1932. At the time of his death he was our senior consultant. Generation after generation of medical students passing through the "Royal" were instructed by him. A man of sterling character, there dwelt beneath his rugged exterior a spirit of the very greatest kindness.

Mr. Hanna was connected with our Hospital for a period of nearly forty years. As a specialist in diseases of the eye, ear, nose, and throat, he has bequeathed to us a memorial of the most eminent and devoted service. The high esteem in which he was held by his colleagues is indicated by his election to the presidency of the Irish Ophthalmological and the Ulster Medical Societies and also of his special section of the British Medical Association in 1937. He was chairman of the honorary visiting staff of the Royal Victoria Hospital at the time of his retirement. We honour and respect the memory of these two great men, and wish to extend to their families our deepest sympathy.

Let us linger for a few moments to pay tribute to the memory of three gallant young medical men, Humphrey Thomson, Robert Marshall, and Norman Purce, sons of members of our visiting staff, who, on the threshold of a life of the richest promise, made the supreme sacrifice in answer to the call of duty.

To-day it gives us great pleasure to welcome home and to the honorary medical staff, Lieutenant-Colonel Eric McMechan and Surgeon-Lieutenant Maurice Brown. We also extend a hearty welcome to two newly-appointed members of the honorary

medical staff, Mr. R. J. W. Withers and Dr. Reginald Hall. We are glad to have back with us again on the auxiliary staff Lieutenant-Colonel R. W. M. Strain, Squadron/Leader J. Nelson, Majors J. C. Davidson and D. F. C. Dawson. One of the most welcome features of the work at the Hospital during the past year has been the presence in our midst of so many post-graduate ex-service men as registrars and supernumerary house-surgeons in the various departments.

Lastly, and not least, we would like to extend a hearty welcome to Brigadier T. W. Davidson as our medical superintendent, and to Miss Elliott as matron of the Hospital, and to wish them both every success.

As my text for this morning I have chosen the development of neuro-surgery in the hope that something might be learnt, on the one hand, by reflection on the superstition and error which so long held science in bondage, and, on the other, from a consideration of the notable achievements of workers, not only in the domain of nervous disease, but also in that of the cognate departments of medicine, which have resulted in neuro-surgery being what it is to-day. The story is a long one, and is paralleled in the annals of any of the other branches of surgery, but if the examples which our study portrays of the unselfish devotion to duty of the pioneers of neuro-surgery should serve to stress the importance of a high professional code of conduct, I shall feel that such study as I have made of the subject has been well repaid.

Though the surgery of the nervous system is one of the youngest of the surgical specialities, there is considerable evidence to support the contention that operation on the skull was one of the earliest crafts resorted to by man in his attempt to deal with morbid states of the body. The researches of anthropologists have shown that trepanning was carried out by our ancestors beyond the dawn of history. That man had the temerity to make openings in the skull, and was able to do so successfully during the Late Stone Age, when he had nothing more serviceable to work with than a piece of flint, is well authenticated. What led the operator to undertake such an admittedly difficult and dangerous procedure, or the subject to submit to it, is a matter for conjecture, but there seems to be little doubt that the practice had its origin in a superstition which prevailed through all centuries of recorded time and is not without its adherents in our own day, namely, that of demoniac possession. The discoveries in regard to prehistoric trepanning date back to the year 1865, when a French general practitioner, Dr. Pruniere, exploring a dolmen, came across a human skull from which a large portion of bone had been cut away. At one point, the margin of the opening was curiously smoothed, and Pruniere came to the conclusion that the skull had been fashioned to make a drinking utensil—a practice not unknown amongst the savage peoples of to-day—a libation from such a vessel apparently enhancing the ecstasy of the victory already established over an erstwhile enemy. That Pruniere was wrong in his conjecture was proved by Professor Broca in 1877. He demonstrated that the smooth portion of the opening in the skull discovered by Pruniere, and the margins of many other “holed” neolithic skulls unearthed in France and other parts of Europe, showed indisputable evidence of a healed process, indicating that the artificial hole had been made during life. Tre-

panning was practised until quite recently by some of the few primitive peoples that still exist in the islands of Melanasia. These primitives carry out the operation for headaches, epilepsy, and some forms of insanity, employing fragments of volcanic glass, hard shell, or sharks' teeth for the purpose. Some of the tribes in New Ireland carry out the operation for depressed fractures sustained in combat : here, therefore, the procedure has a rational pathological basis, though amongst the New Irish trepanning is also sought by healthy individuals as a means of ensuring longevity.

Leaving the folk of the Stone Age and our present-day primitives, let us consider what research amongst the records left us by man down through the centuries has to tell concerning our subject. The oldest known scientific treatises are those of the ancient Egyptians, covering the period of from about 3500 to 1000 B.C. The story of this long expanse of time, during which Egyptian kingdoms waxed great only to fade again, is contained in the documents which have been recovered from their tombs. These portray their development from the earliest attempts at an organised community, with chipped flints and vessels of earthenware and stone, up to that of a highly sophisticated culture, with exquisite jewellery, graceful pottery, oil-cups and candles, razors, and what not. Our knowledge of Egyptian medicine is obtained from their papyri, or papers, of which the Edwin Smith papyrus, written in the sixteenth century before Christ, is chiefly surgical. In it forty-eight surgical cases are described, twenty-seven of which were head injuries. Deafness in fracture of the temporal bone is noted. In cases of closed fracture of the skull, decompression at the point of contusion is advised, but what instruments were used or how the operation was carried out is not known. Paralysis of the limbs and sphincters, in association with dislocation of the cervical spine, is regarded as being attended with a grave prognosis. In view of the present trend towards specialisation and the development of a State Medical Service, it is interesting to note that during the decadent period of Egyptian culture (about 1500 B.C.), medicine became very highly specialized; so that, as Herodotus tells us, "each physician applies himself to one disease only and not more."

To the ancient Greeks, who so greatly enriched mankind in nearly all branches of the arts and sciences, we owe the scientific approach to medicine. Hippocrates, the father of medicine, who lived and worked in the most illustrious period of Greek civilisation (about the fourth century B.C.), and the Hippocratic school, casting aside the elements of mysticism and vain speculation which had dominated the healing art from remote antiquity, introduced the careful and systematic clinical observation of the signs and symptoms of disease. Therapy was established on sound principles of inductive reasoning from experience gained at the bedside, and a practice of medicine based on the highest ethical standards was inculcated. Though the anatomy of the period was restricted to what could be observed on external examination of the body and pathology was very limited, yet it has been remarked that the Hippocratic descriptions of many diseases are so adequate that they might be transferred unaltered into any modern textbook. Hippocrates regarded all diseases as being due to a disturbance of the fluids or humours of the body. He

was contemptuous of the prevalent superstition that epilepsy was due to demoniac possession, regarding it rather as hereditary in nature and due to an affection of the brain itself, probably associated with an inundation of the gland with a condensed phlegm which could no longer be secreted. He based this hypothesis on the examination of goats which had died in convulsions, relating how, when the head was cut open, the brain was found to be humid, full of sweat, and having a bad smell. For him the brain was the seat of knowledge and of ability to discriminate between good and evil. He thought that excess of humidity of the brain was the cause of madness. Hippocrates wrote a book on head injuries which indicates a wide experience in this type of traumatic surgery. He emphasised the fact that no injuries of the head were to be regarded as trifling, since even a wound of the integuments might prove fatal. His classification of skull fractures is almost modern in complexion. The use of a trephine, quite up to date in appearance, is advised in certain cases. He emphasises the importance of cleanliness, good light, the proper positioning of the patient, and states that, as the trephine tends to become hot, it should be cooled from time to time, and that the greatest care must be taken to avoid injury to the dura. The subsequent wound-dressing employed was either a preparation of wine and honey or of tar—virtually an antiseptic application. He taught that primary healing of wounds should be aimed at and that suppuration was neither necessary nor indeed ideal, as was the doctrine not only of his predecessors, but remained the belief of those who followed him for close on two thousand years. According to the late Sir Charles Ballance, Hippocrates recommended the use of the trephine in cases of incipient blindness not due to disease of the eye. Thus, the father of medicine may have employed decompression for increased intra-cranial pressure, a procedure the value of which only came to be appreciated again some sixty years ago.

With the passing of Hippocrates, the glory of ancient Greece soon began to fade, though the establishment of the Museum at Alexandria in 331 B.C. kept the Hippocratic tradition alive for a time. Alexandrian medicine, however, soon developed into a school of empiricism, and before long therapy was once again a matter of exorcisms and charms and other forms of magic.

The western Roman Empire, which held sway over most of Europe from the second century B.C. to the sixth century A.D., had little interest in scientific medicine. Whilst the Romans prosecuted military science, the codification of laws, and the development of sanitation with assiduity, they depended largely on domestic herbals, votive offerings in the temples, and other superstitious observances in case of illness. Certain famous Greek physicians did indeed set up their consulting-rooms in Rome, but as the proud Romans despised and were suspicious of foreigners, it was some time before they attained a reputation for respectability. Eventually, by reason of their superior learning, their services came to be highly valued, and they were employed to look after the famous gladiators and gymnasts, though, unfortunately, the scientific outlook of the Hippocratic school was gradually replaced by a fondness for theorising, and medicine suffered accordingly. A few of the greater physicians of the earlier centuries of this period will be briefly alluded to because of the pro-

found influence exerted by their teaching on medical thought until well on in the Middle Ages. Celsus, whose name is well known to you in connection with the four cardinal signs of inflammation, wrote an important treatise 'concerning things medical' in A.D. 30. He indicates that under the Romans, operations were carried out for a wide variety of conditions, and that the surgeons of the period were equipped with many well-constructed instruments. Indeed, the standard of surgery which then prevailed was not attained to again until the time of Ambrose Paré in the sixteenth century.

Celsus deals with the problem of head injuries in considerable detail. He gives a good classification of skull fractures, and signifies his belief that these sometimes arise by *contre coup*. He urges careful enquiry regarding the immediate symptoms, such as unconsciousness, convulsions, loss of speech, etc., for if such have occurred, the outlook is serious. But if *torpor* develops with paralysis, the membrane of the brain is injured, and little hope need be entertained of recovery. When probing of a wound leaves uncertainty concerning the presence of fracture, he says a useful tip is to pour in some ink and scrape the bone, when a fissure will show as a black line. He mentions that bleeding from the membrane of the brain may occasionally occur in the absence of fracture, producing a clot with great pain and dimness of vision. In cases of compound fracture, he counsels an expectant attitude with local applications to allay irritation, such as wool soaked in vinegar. If, after a few days, there is no improvement, and fever sets in, with great pain and swelling on the glands in the neck, he advises opening the skull with a wimple, a sort of augur, and removing the fractured or depressed bone. In cases of epilepsy, he favours shaving the head and applying cupping-glasses, and in desperate cases resort to the use of the cautery.

Galen, who practised in Rome in the second century A.D., was the greatest Greek physician after Hippocrates. He was a man of outstanding talent, a great experimentalist, and a voluminous writer, but didactic and boastful and an incurable theorist. There was no problem for which he had not a ready answer. He was a monotheist, and emphasised the subservience of the body to the soul, so that his teaching met with the unqualified approval of the Christian Church. Indeed, in course of time, Galen's pronouncements came to be regarded as infallible, and his works remained a sort of Bible of Medicine until the time of Vesalius. Though he contributed greatly to the advancement of anatomy and physiology, his statements were by no means always correct, and his mania for speculation led him into many extravagant errors, which did much to delay the advance of medicine; for example, he subscribed to the pernicious doctrine that suppuration was an essential process in healing. After Galen, the quality of medicine and surgery quickly declined, and there was a steady deterioration in the ethical standards of the medical profession. Medicine in Byzantium, which had taken over after the barbarians had swept down into Italy, was largely given over to charms and spells, and salves and plasters to encourage laudable pus.

During the decline in Europe, which was destined to continue for well-nigh on a thousand years, medicine found sanctuary for a time in the great Moslem Empire.

In the seventh century, when Islam was rapidly extending its borders, its followers were hostile to all forms of science. Once the wars of conquest were over, however, the Arabs, who were able mathematicians and chemists, became interested in science, and their rulers greatly encouraged the introduction of learning from abroad. They commenced eagerly the translation of the Greek authors, including some of the Hippocratic collection, into Arabic. The Moslems, however, contributed little to medicine and still less to surgery, but to them is due the credit of preserving many of the works of the ancient Greeks and of transmitting them on to Europe at a later date.

During the Dark Ages European medicine was largely in the hands of the Church. The downfall of Rome had left the peoples of Europe in a state of chaos and at the mercy of wandering barbarians. An illuminating picture of the state of affairs at this time is given by Matthew Arnold in his well-known lines :—

On that hard pagan world disgust  
And secret loathing fell,  
Deep weariness and sated lust  
Made human life a hell.

The Christian Church, with its mission of compassion for suffering, established monasteries dedicated by their founder, St. Benedict, "to prayer, study, and the healing of the brethren." Within their cloisters provision was made for the care of the sick. Little wonder that a distracted people, amongst the seething turmoil of the period, should seek the protection of the Church, particularly as the physicians of the time were utterly powerless in face of the devastating epidemics which swept the Continent at frequent intervals. Many of the monasteries came in time to have hospitals and physicians of their own, and in this way, possibly, originated the earliest hospitals in Europe. The Church, however, held certain views that were inimical to progress. Disease was attributed in many instances not to natural causes, but to divine retribution for sin, and was therefore naturally to be met by prayer and fasting rather than recourse to medicine.

The Church encouraged the monks to translate the Arabist versions of the works of the ancient Greeks into Latin. As already mentioned, the writings of Galen were especially esteemed by the Church, but, unfortunately, Galen had said that surgery was to be regarded merely as a branch of medicine, and this had been interpreted by the Arabs as meaning that surgery was an inferior type of work. This dangerous conception of the place of surgery was now carried forward into mediæval medicine. Physicians came to regard any method of treatment which involved the shedding of blood as beneath the dignity of anyone with the least pretence to culture. Surgery was therefore left, for the most part, in the hands of men not only devoid of culture, but without any regard for ethics, such as barbers, executioners, booth-keepers, sow-gelders, and charlatans of all sorts. Individuals of this type wandered about from village to village blood-letting, cutting for stone, operating for hernia, and combining these activities with sooth-saying and magic. Amongst these itinerant quacks were individuals who professed to be able to relieve insanity, idiocy, and other forms of mental disorder. A superficial incision was made in the scalp of the unfortunate victim, and stones, palmed in the hand of the operator,

were dexterously extracted from the wound at well-chosen intervals, and cast into a pail, conveniently placed, to the amazement and delectation of the onlookers, if with but little consolation for the sufferer. The great masters who taught at the few European universities, which had by this time sprung up, undoubtedly laboured on a loftier plane, but for the rank and file of the people the standard of medicine was very low and surgery often more dangerous than the disease. Many placed their faith in pilgrimages, incantations, and exorcisms, sorcery, and suchlike. A compilation of the great Salerno school, the first university in Europe, tells us that "blood-letting is the beginning of health. It strengthens the mind and memory, purges the bladder, dries out the brain, warms the spinal cord," and so forth, and, indeed, is as extravagant in its claims as some of the quack remedies of the present day. During the Middle Ages a few great masters of surgery did what they could to advance their art, but their teaching had little effect on their contemporaries. Theodoric, bishop of Cervia, wrote in 1266 :—"For it is not necessary, as all modern surgeons profess, that pus should be generated in wounds. No error can be greater than this. Such a practice is bound to hinder nature, to prolong the disease, and prevent coagulation and consolidation of the wound." But the correctness of his statement was not to be established for another six hundred years. Theodoric affirmed that an injury to one side of the head might produce paralysis of the contralateral side of the body. About thirty years later Lanfranc, working in Paris, and in effect the founder of French surgery, contributed further to the elucidation of the problem of head injuries by describing cerebral concussion for the first time, and pointing out that it was by no means necessary to resort to trephining in all cases of skull fracture, nor did the fragments of bone require to be removed unless they were pressing on and irritating the brain and its membranes. In the treatment of head injuries in the more advanced medical schools of the period, it was usual first to explore the wound gently with the finger, for, according to one author, there is no better method of recognising a fracture. If a fracture was found, the wound was enlarged by converting it into a cruciate incision with a razor. The resulting scalp-flaps were retracted with a blunt hook until the whole extent of the fracture was exposed. Loose bone-fragments having been removed, and bleeding controlled, the flaps were turned back into place, and the head bandaged with a linen cloth, previously soaked in white of egg. Roger of Salerno laid it down that any patient with a fractured skull must be regarded as in danger for a hundred days. A famous Italian surgeon of the thirteenth century, who endeavoured to put surgery on the same footing as medicine, makes a remark, possibly for the edification of his son—a medical student—which gives one an insight into the regard in which surgery was then held. He says : "A wise surgeon will refrain from stealing when he is actually in attendance upon a patient," and "that discretion should lead him not to employ reputedly bad characters as assistants."

The first step towards a recovery of the scientific spirit in medicine was in the domain of anatomy. Vesalius, in 1543, published his monumental treatise on human anatomy, "The Fabrica," which terminated for good and all the belief in the

infallibility of Galen which had pervaded medicine for thirteen centuries. Dissection of the human body was revived, and from henceforth the student of anatomy gained his knowledge at first hand. The spirit of investigation was once more abroad, and it was not long before the work begun by Vesalius had made itself felt in the realm of surgery. Ambrose Paré, the great French military surgeon of the sixteenth century, and one of the greatest surgeons of all time, introduced a rational attitude to the treatment of wounds, which, at the time, were being flooded with boiling oil, in the belief that they were invariably poisoned. He instituted in place of this savage custom, the principle of handling the tissues with the utmost gentleness and employing only such dressings as were non-irritating. He laboured incessantly to rid men's minds of the superstition that suppuration was a beneficent process, and to bring them to realise that healing was really effected by the tissues themselves. Advance in the science of physiology lagged somewhat behind that in anatomy, and it was not until 1628, for example, that William Harvey published his discovery of the circulation of the blood. By this time the microscope and thermometer, invented by Galileo, had become available. Medical science, already infused with a new spirit of research, began to make use of them; and soon scientific knowledge of the workings of the human body was replacing age-old theories, such as that of the four humours. Attempts were made to correlate the signs and symptoms of disease with the underlying pathology and to institute a rational therapy. Internal medicine was at last established on scientific grounds.

In 1760, Percival Pott published an important treatise on head injuries. In this there is an admirable account of extradural abscess following external violence to the head. He describes eleven cases treated by himself belonging to this group, in none of which was the skull fractured, and in six, indeed, the only visible evidence of local trauma was simple bruising of the scalp. It was in connection with these cases of extradural abscess that Pott described the puffy tumour with which his name is still associated. Of the eleven cases, three refused operation, and in a fourth interference was limited to the scalp; all of these patients died. In the remaining seven cases, trephine holes were made and the extradural abscess drained, and all except two recovered. Instead of the cruciate incision used from remotest antiquity, Pott exposed the skull by the unique method of cutting out a complete circle of scalp of whatever size seemed desirable. He divided skull fractures into those with and those without depression, and stated that use of the usual complex classification "is merely to load the memory without informing the understanding." He operated on all cases of depressed fracture, sacrificing the displaced fragments unless the injury was slight, when the bone was levered back into position. It was recognised by him that disturbance of consciousness might be due either to commotion of the brain or to compression by clot. He did not know, however, of any way of distinguishing between the two, though he states that impairment of consciousness developing immediately after an injury is more likely to be due to commotion of the brain, and, if delayed, to be the result of compression. He points out that the difficulties are further increased by the fact that there is no way of knowing when a clot is present, where it may be situated, and declares that



the whole problem of unconsciousness following head injuries is "involved in the most perplexing obscurity." Because of the impossibility of excluding the presence of a clot, he recommended the use of the trephine in all cases of fracture of the skull without depression, if the level of consciousness did not improve satisfactorily in spite of many and drastic bleedings, provided always that there was some evidence, in the form of a visible scalp lesion, to indicate where to make the perforation.

Again, the difficulties of localization were so unsurmountable that even in cases in which the presence of a clot seemed almost certain, he cautioned against the use of the trephine unless there was a local scalp injury to indicate where to operate. He recognises that this method of determining the site at which the skull opening is to be made is fallible and uncertain and that the clot may be far distant, but it is the only method available, and, unfortunately, the chances of the operation being serviceable are very few. Pott subdivided intra-cranial hæmorrhages into extradural, subdural, and intra-cerebral. He mentions the fact that he opened the dura for a clot situated beneath the membrane, but states that the procedure must be recognised as being attended with great hazard. The trephine which he employed was similar to the short-handled instrument that is occasionally used even at the present time.

Though Pott added considerably to our knowledge of head injuries, and men like himself and Chiselden did much to improve the craftsmanship and widen the scope of operations in general, no new principle was introduced into surgery from the time of Paré until the advent of John Hunter towards the close of the eighteenth century. Hunter founded the sciences of experimental and surgical pathology, and opened the way for the scientific application of surgery to the relief and cure of disease. He taught men that the true function of surgery was to seek out the cause of each malady, and to try and prevent it rather than to be content with measures directed towards the eradication of morbid processes already firmly established.

During the first half of the nineteenth century, surgical technique was developed to a state of perfection that could scarcely be excelled. It was inevitable, since no methods of relieving the excruciating pain of operation other than a dose of opium or a draught of whiskey was available, that speed and dexterity, combined with a precise knowledge of anatomy, were the hallmarks of the truly great surgeon. But the necessity for speedy surgery diminished the field of its application, and any inclination there might have been to employ a conservative procedure had often to be relinquished in favour of an operation of a sacrificial nature which could be more rapidly executed. But the restricted application of surgery was also determined by what the unfortunate patient was able to endure. The necessity for an anæsthetic was plain enough, and a solution of the problem was being eagerly sought. When Morton, in America, introduced ether in 1842, and Simpson of Edinburgh discovered chloroform in 1857, their names were at once on everyone's lips. The elimination of the agony until then inseparable from operative treatment was an advance the magnitude of which can hardly be computed. But it did not

widen the application of surgery as much as might have been expected. There was still the spectre of sepsis overshadowing all and stepping in almost as frequently to undo the best efforts of the operator. Even in the most up-to-date hospitals of the day, sloughing and gangrenous wounds were rife; secondary hæmorrhage an ever-present danger. It is said that Sir Astley Cooper, who, in 1820, removed a wen from the royal scalp of George the IV of England, was sick with anxiety, and could scarcely sleep for a couple of weeks, lest the wound should go septic and prove fatal. But good fortune attended his efforts, and he received a knighthood.

Apart from ovariectomy, the surgery of the body cavities was not attempted, it was so uniformly fatal. As far as the surgery of the nervous system was concerned, it was restricted to the treatment of scalp wounds and skull fractures. Knowledge of the physiology of the nervous system was very limited. That mental aberration, intellectual deterioration, or palsy might be the result of a space-occupying lesion within the skull was rarely thought of, except by some of the great physicians with an interest in neurology.

In 1867, just ten years after chloroform had become available, Lister introduced the principle of the antiseptic treatment of wounds which was to revolutionize the entire outlook of surgery. Within the next decade only hopeless surgical diehards continued to take unction to themselves because the flower in their buttonholes was undisturbed and their cuffs immaculate at the end of an amputation. Instead, surgeons everywhere were operating successfully for conditions that had hitherto been regarded as inoperable, such as lesions of the stomach and colon, gall-stones, renal tumours, and what-not. New techniques were established, and within a quarter of a century not many of the viscera could be regarded as sacrosanct from attack by the knife. Two regions of the body, however, remained, the surgery of which was slower in being developed than was the case elsewhere; partly on account of the difficulties of operative approach, but more so because the physiology and pathology of the contained viscera were not so well understood. I refer to the thorax and the central nervous system: my remarks will be restricted to the surgery of the latter.

At the time of Lister's introduction of the antiseptic principle, knowledge of diseases of the nervous system had already been considerably advanced by physicians and neurologists such as Robert Whytt, Richard Bright, William Stokes, and many others. Histologists and pathologists had made valuable contributions in regard to the normal structure of the nervous system and the changes wrought by disease. Experimental physiologists, amongst them Sir Charles Bell, Marshall Hall, Flourens, Majendie, Johannes Müller, to mention but a few, had established many facts of fundamental importance to an understanding of nervous function, but as yet only the fringe of this vast field could be said to have been explored. Von Helmholtz invented the ophthalmoscope in 1850, and already this instrument, so indispensable to all concerned in the study and treatment of diseases of the brain, was in use. In 1862, Broca discovered that the posterior end of the third left frontal convolution was the centre for articulate speech in right-handed individuals. He

was the first to trephine for a cerebral abscess, the situation of which had been diagnosed by his theory of cortical localization. Prior to the introduction of Lister's antiseptic principle, a brain tumour had never been removed successfully; indeed, the mere suggestion that such a project might some day prove feasible had been severely censured as bordering on a surgical impropriety. Apart from the centre for articulate speech, knowledge of the localization of cortical function was non-existent. Information concerning the function of the deeper parts of the brain was limited to a few salient facts, such as the presence of the vital centres in the medulla and the centres for co-ordination of movement and equilibration in the cerebellum. Accurate localization of a brain tumour, let alone its removal, would have been impossible at this period, when the pioneers in abdominal surgery had already made great advances and were doing magnificent work in reducing the sum total of human suffering and disability.

Neurologists such as Hughlings Jackson, David Ferrier, Gowers, and Charcot were busy in the latter half of the nineteenth century unravelling the syndromes of neurological disorders and building up, along with experimental physiologists, pathologists, and others, that great storehouse of knowledge on which the surgery of the nervous system was to be based. It was not long until tumours of the brain and spinal cord were being localized with a considerable degree of accuracy, but the surgeons of the day were not equipped to deal with them. Thus the pathology and life history of tumours of the nervous system were far from being fully understood. The circulation of the cerebro-spinal fluid had not yet been worked out, and the hydrostatic factors complicating space-occupying lesions within the skull had still to be learnt by bitter experience. The earliest attempts at removal of a brain tumour, even when correctly localized and benign in character, were almost invariably fatal. The first removal of a cerebral tumour was carried out in 1884 by Mr. Richman Godlee, who excised an encapsulated glioma about the size of a walnut from the post-central gyrus of a young farmer of 25 years. The position of the growth had been correctly localized by Dr. Hughes Bennett, who was present at the operation along with Hughlings Jackson and David Ferrier. A carbolic spray was kept going continuously throughout the procedure. The usual cruciate incision was made in the scalp and discs of bone were cut out with a trephine. The patient made good progress during the first three days after operation, but on the fourth the wound was swollen and there was a discharge with a decidedly putrefactive smell. A cerebral fungus had already developed by the fifth day. The patient died on the twenty-eighth day apparently as a result of a complicating infection. This might well have been the first successful removal of a brain tumour but for one unfortunate factor that was overlooked, namely, that at the time of operation the patient had several raw areas on the upper part of the back of his neck, resulting from the application of blisters to this region.

During the last two decades of the nineteenth century, knowledge of cerebral localization was immeasurably increased by the research of men like Ferrier and Sherrington in this country. One of the most brilliant workers in this field was Sir Victor Horsley, who may be said to have established the surgery of the central

nervous system on a scientific basis. Horsley standardized the methods of operative approach for brain and spinal cord tumours; thus the cruciate incision followed by a trephine opening was replaced by the semicircular scalp incision and osteoplastic bone flap now in use. He was one of the first to realise that vision could be preserved, headache relieved, and life prolonged by making a decompressive opening in the skull, and was the first to employ this procedure expressly for such tumours as were inaccessible or irremovable. Working in association with Sir William Gowers, he carried out the first successful removal of a spinal-cord tumour in 1887.

The pioneers in neuro-surgery had many technical problems to solve. Methods of handling the tissues which were perfectly satisfactory in other situations, such as sponging with gauze, ordinary modes of retraction, exploration with the fingers, and so forth, proved calamitous when applied to the delicate neural mechanisms. The use of small cotton patties and strips of gutta-percha and lintine to minimize the trauma produced by the lightest of malleable retractors had to be evolved. Ordinary methods of hæmostasis were found to be of little service. Loss of blood during a long-drawn-out struggle with a brain tumour averages about three to four times that of most major operations. Unless the greatest care be exercised, hæmorrhage may in itself determine a fatal issue, and special methods of hæmostasis had to be devised for every layer inwards from the scalp to the bed of the tumour. The methods in use to-day were only evolved very gradually and after much tribulation, and I will refer to some of them as we proceed. An early and most important advance was Horsley's solution of the problem of diploic bleeding by the use of wax.

As ordinary methods of exploration are inadmissible, accurate localization of a brain lesion is necessarily of capital importance. Unless the precise situation of a lesion is known, so that the surgeon may make the skull opening directly over it, removal either proves impossible or is attended with so much damage that the patient promptly succumbs or is left with such permanent incapacity that his survival may well be a tragedy. The neurologists and neuro-surgeons of fifty years ago had to rely solely on clinical methods of localization, and since even to-day the site of many brain tumours cannot be predicted by the most astute clinical judgment, it will be readily recognised that the position of the early neuro-surgeons was not a very enviable one.

Perhaps the most heart-breaking of all the problems of the pioneers in brain surgery was that of the raised intra-cranial pressure, which complicated so many of their cases and led to a devastating extrusion of cerebral tissue as soon as the dura was opened. Numerous expedients had to be resorted to before some sort of solution was forthcoming. The substitution of local for general anæsthesia by de Martel and others was found to diminish the hazard of operation to a certain extent. Some years were to elapse before Harvey Cushing found that an ominous situation might sometimes be transformed by the simple expedient of lumbar puncture. Still later, the insertion of a canula into the opposite ventricle, methods of dehydration, and intravenous administration of hypertonic solutions were pressed

into service. Related to the problem of increased pressure was that of leakage of cerebro-spinal fluid from the wound after operation, which frequently led to meningitis and death. To overcome this a special technique of wound closure had to be evolved, in addition to measures to control intra-cranial pressure post-operatively. Add to all this that many cerebral tumours are malignant or, if benign, so placed as to render access very difficult, and it can be readily understood why the successful removal of a brain tumour was not often attained in the early days of neuro-surgery.

One of the fields in which encouraging results were first secured was in the treatment of intra-cerebral abscess. Dr. Gowers and Mr. Baker recorded a successful case in 1886, and reports of a few similar results followed during the next few years. Knowledge of the subject was still very fragmentary, however, until Sir William McEwan published his classical work on the subject in 1893. Of twenty cases of intra-cerebral abscess on which he had operated, all except two recovered, giving an operative mortality of 10 per cent. McEwan's figures have not been surpassed or perhaps even equalled up to the present day. The precepts inculcated by him were soon being widely practised, and have resulted in the preservation of an untold number of useful lives.

In the opening year of the present century, a brilliant young surgeon named Harvey Cushing, who had just recently been appointed to the staff of the Johns Hopkins Hospital, Baltimore, decided to devote his life to the surgery of the nervous system. In preparation for his task he spent a year in Europe. After a brief visit to Horsley in London and a short stay in France, he went on to Berne, where he carried out investigations on intra-cranial pressure at the suggestion of Kocher. Finally, after a period in Italy, he spent four months with Sherrington in Liverpool. Returning to America in 1901, he gradually built up a school of neuro-surgery, first in Baltimore and subsequently in Boston, which came in time to make the United States the Mecca of neuro-surgery. Many of the famous neuro-surgeons of to-day were at one time or another pupils of Cushing's, such as Cairns and Dott in this country. Cushing's influence on neuro-surgical work was transcendental. There was a steady emanation of new ideas from his clinic: now some advance in operative technique, again the syndrome characteristic of a certain region, or it might be a classification of tumours belonging to a particular group facilitating their diagnosis and treatment. Two problems which perhaps not unnaturally engaged the attention of the pioneers in neuro-surgery at a very early stage were, the prevention of blindness due to pituitary enlargements and the relief of the inveterate pain of trigeminal neuralgia. The physiology of the tiny gland, once thought to be the habitation of the soul, and later allocated the more lowly office of producing the nasal secretions, was worked out by Cushing, and the enlargements to which it was subject were clearly defined. The endo-nasal operation devised by him for the relief of pressure on the optic nerves and chiasm remains the ideal one for certain types of pituitary growth even to the present day. Subsequently, an approach along the floor of the anterior fossa came into favour for the removal of tumours extending upwards through the diaphragma sellæ. X-ray therapy has proved invaluable in consolidating the visual improvement obtained by

operation, and it may indeed be the only form of treatment necessary when vision is not as yet seriously compromised.

Even before Lister's day, attempts had been made to relieve the almost unbearable pain of trigeminal neuralgia by dividing the main nerve trunks just outside the skull. Unfortunately, this difficult feat only resulted at best in temporary relief. Alcohol injection of the roots was not any more lasting in its effect. Attention was then directed to the gasserian ganglion, which was either injected with alcohol or completely rooted out. But these latter procedures, besides being dangerous and technically very difficult, had the drawback that vision in the corresponding eye was imperilled because of anæsthesia of the cornea. In 1901, Frazier, in America, introduced the less difficult operation of division of the sensory root of the fifth nerve behind the ganglion, at first completely, but later only in its outer two-thirds, so that corneal sensation was preserved and danger to vision eliminated. Frazier carried out this operation over one thousand times with a mortality rate of only a fraction of one per cent. Recently a Swedish surgeon has gone a step further, dividing the pain fibres, and the pain fibres only, as they lie within the brain stem.

At one time all tumours arising within the brain substance were considered so hopeless that they were just lumped together and classified as sarcomas—the most deadly of all tumours. Neuro-pathologists, however, demonstrated that these tumours arise from the supporting cells of the brain—the glia—and renamed them gliomata. Many types of glioma are now recognised, varying greatly in malignancy. Some are of such a fulminating nature that all forms of treatment are unavailing. Others melt away rapidly with complete relief of symptoms under the influence of X-rays, though, unfortunately, the respite is rarely for long. Still other gliomas, if completely excised, do not recur, and a lasting cure is provided. Thus the cerebellar astrocytomas of young people are amongst the most favourable of all intracranial new growths. The sorting out of the gliomas into different groups, the behaviour of which could be predicted from their cellular structure, was one of the finest achievements in neuro-surgery, and much of the credit belongs to the brilliant workers of the Cushing school. In the treatment of the gliomas, the help of the neuro-pathologist is indispensable. If the latter is supplied with a minute particle of the growth, he can tell the surgeon within a few minutes the type of glioma with which he has to deal. The surgeon is thus furnished with an invaluable guide on which to base his treatment. If the growth is a highly malignant one, for which operation would be quite futile, he will know to stay his hand. On the contrary, when the tumour is of a favourable nature, he will not permit himself to be easily turned aside from an effort to effect a complete removal. Though the number of cases in which operation is unprofitable is regrettably high, the outlook in regard to the gliomas in general is far from being as gloomy as was depicted a decade or two ago. Indeed, the results that can be achieved do not fall far short of those secured in cases of malignant disease in many other parts of the body.

One morning in 1895 the entire news-reading world was startled by the announcement that a ray with quite fantastic powers of penetration had just been discovered. Röntgen's name was at once a household word. Ill-informed speculation abounded,

and great alarm was felt in many quarters lest the new rays should get into the hands of unprincipled persons and be adapted to nefarious purposes; indeed, that the rays might mean an end to all decency and privacy. An enterprising London firm increased its turnover very handsomely by the sale of X-ray-proof underwear, and refined folk in New York made determined efforts to have legislation brought in prohibiting the "use of X-rays in opera glasses." In medical circles interest in the new discovery, though more prosaic, was equally great. In the domain of neuro-surgery films of the skull and spine furnished information of prime importance in cases of trauma, and evidence of diagnostic and localizing value was occasionally forthcoming in cases of brain and spinal-cord tumours. It was not, however, until 1918, when Dandy demonstrated that air could be used as a contrast medium to outline the ventricles, that the diagnostic value of X-rays came to be utilized to the full. Dandy thus provided a method whereby not only the situation but also the size of most brain tumours could be determined, and his contribution was epochal in importance. Another highly specialized form of radiological investigation, the possibilities of which have not yet been properly evaluated, is that of cerebral arteriography, in which an opaque medium is injected into the carotid and vertebral arteries, and X-ray shoots are made within the next few seconds. Departure from the normal configuration of the intra-cranial vessels affords a means of localizing such tumours as are clinically mute, and it is thought by those entitled to give an authoritative opinion that cerebral arteriography may come to supply not only a topographical, but also a pathological diagnosis, when the vascular pattern of the various types of brain tumour have come to be sufficiently well known.

It would be wearisome to discuss all the important contributions to neuro-surgical technique that have been made since the beginning of the present century, and I shall restrict myself to a cursory reference to those of pre-eminent value. Mention might first be made of the simple device introduced by Cushing in 1911 for the control of the medium-sized vessels of the brain and meninges—the silver clip. The invention may not sound impressive, but it received the immediate blessing of neuro-surgeons everywhere. The vexatious and time-consuming manipulations necessary to control the fragile cerebral blood-vessels by ligature were superseded by an expedient precise, simple, less injurious. Another innovation of great value, evolved by Horsley and Cushing independently, was the so-called "muscle-stamp," for the control of oozing from the dura, the walls of the large venous sinuses, etc. A contribution of signal value was the introduction of the high-frequency current for the coagulation and cutting out of intra-cranial tumours by Cushing and Bovie in 1926. Diathermy served a dual purpose: it reduced the incidence of bleeding in intra-cranial work in general and paved the way for the extirpation of many tumours, the removal of which previously had had to be abandoned because of difficulties of access. It so happened that many of the tumours in which risks attending removal had been prohibitive were benign: the meningiomas, acoustic neuromas, cholesteatomas, and so forth comprising about 35 per cent. of intra-cranial growths. Thus the importance of endothermy to neuro-surgery can scarcely be exaggerated; it greatly increased the number of brain tumours in which hope of lasting cure might be entertained.

Two very recent additions to our operative resources which may well prove to rank in importance with those just mentioned, are substances prepared by the fractionation of human blood plasma, and named 'fibrin foam' and 'fibrin film' by their originators, Ingraham and Bailey of Boston. The foam is of immense value as a hæmostatic agent, whilst the film provides an excellent dural substitute which, as it does not develop adhesions to the underlying brain, may go a long way towards a solution of the problem of traumatic epilepsy.

In any history of neuro-surgery mention must be made of Professor Geoffrey Jefferson of Manchester, who was largely responsible for the inauguration of the British Society of Neuro-Surgeons in 1924, and who has remained one of the leading figures in neuro-surgery in this country since that date. He has been responsible for many important advances to which time, unfortunately, does not permit me to make reference. Amongst other distinguished pioneers in neuro-surgery in this country were Sir Charles Ballance, Wilfred Trotter, Sir Percy Sargent, Bathe Rawling, and Donald Armour, and also Mr. Adams McConnell of Dublin.

It is hardly necessary for me to allude to the way in which the gloom enshrouding the subject of pyogenic infections of the central nervous system was so largely dispelled by the introduction, first, of the sulphonamide drugs, and later, and more particularly, of penicillin. Many suppurative intra-cranial affections previously uniformly fatal clear up as if by magic, provided chemotherapy is instituted promptly and intelligently, e.g., pneumococcal meningitis, septic thrombosis of the cavernous sinus, diffuse subdural abscess. During the recent world war, the British mobile neuro-surgical teams, organised by Professor Sir Hugh Cairns, rendered magnificent service in the forward areas of the various battle-fronts. These teams carried their penicillin-sulphonamide powders with them, and carefully sprayed them on the walls of the complicated brain-tracks, which they had debrided at the earliest possible moment. Operations, the magnitude and complexity of which were not even envisaged in the 1914-18 war, were successfully carried out often in a matter of hours of the infliction of wounds so ghastly that, to the uninitiated, hope of survival seemed fantastic. A comparison of the results obtained in the treatment of penetrating wounds of the skull and brain in the recent war with those of twenty-five years ago gives some idea of the progress that has been made in the interval. In the 1914-18 war the death-rate from wounds in which the dura had been penetrated was between 55 and 60 per cent., though Professor Cushing, in his final series of cases, managed to reduce the mortality to what was then considered the astonishingly low figure of 28.8 per cent. In the recent war the death-rate from all forms of penetrating wounds of the brain was in the region of 9 to 10 per cent. (Even patients moribund on admission to hospital, who died within a few hours from overwhelming brain damage and not from infection, are included in the latter series.)

Neuro-surgeons have recently had the temerity to make an incursion into the territory of the psychiatrist, and have shown that certain most distressing and incapacitating forms of emotional disorder may be alleviated by operation. I refer to the procedure known as frontal leucotomy, which was devised by Moniz and



Lima for the treatment of anxiety and depressive states so profound as to render the sufferer incapable of any sort of useful employment. Though the range of application of the operation and a precise knowledge of the tracts in the frontal lobe to which section should be restricted still awaits accurate definition, many hundreds of leucotomies have already been performed, and the results indicate the undoubted merit of the procedure in carefully selected cases; patients who have had to be kept under institutional care for many years being enabled to resume useful and even responsible work with a contented and happy outlook on life.

This brief record of the contributions to neuro-surgery, unfortunately, fails to take note of the spirit which infused the daily lives of the great men who laid its foundations and built up its various departments. Amongst other attributes common to them all was honesty of purpose, a simple desire for the truth and nothing but the truth. It is given to but few in any age to make an outstanding discovery, but this spirit of the pioneers is within the reach of everyone. One might say of each of them, as Shakespeare said of Brutus, "His life was gentle, and the elements so mixed in him that nature might stand up and say to all the world, 'This was a man.' " In conclusion, I do not think I can do better than quote from the short address made by Sir Astley Cooper to the new members of the Royal College of Surgeons when he was president:—"And now, gentlemen, give me leave to tell you on what your success in life will depend. Firstly, upon a good and constantly increasing knowledge of your profession. Secondly, on an industrious discharge of its duties. Thirdly, upon the preservation of your moral character. Unless you possess the first, Knowledge, you ought not to succeed, and no honest man can wish you success. Without the second, Industry, no one will ever succeed; and unless you preserve your Moral Character, even if it were possible you could succeed, it would be impossible you could be happy."

#### BIBLIOGRAPHY

- ADAMS, F: "The Seven Books of Paulus Aegineta," Sydenham Society, 1844.  
 BALLANCE, SIR C. A.: *The History of Surgery of the Brain*, 1922.  
 CAIRNS, HUGH: *A Study of Intra-cranial Surgery*, Medical Research Council, 1929.  
     "The Ultimate Results of Operations for Intra-cranial Tumours,"  
     *Yale Jour. of Biol. and Med.*, May, 1936.  
 CHARCOT, JEAN-MARTIN: *Clinical Lectures on Diseases of the Nervous System*.  
 CUSHING, HARVEY: *Intra-cranial Tumours*, 1932.  
 DAVIS, LOYAL: *Surgeon Extraordinary*.  
 ERICHSEN, SIR J. E.: *Science and Art of Surgery*.  
 GARRISON, F. H.: *History of Medicine*.  
 GRAHAM, HARVEY: *Surgeons All*.  
 GUTHRIE, DOUGLAS: *A History of Medicine*.  
 HORRAX, GILBERT: "Some of Harvey Cushing's Contributions to Neuro-surgery,"  
     *Jour. of Neuro-surgery*, January, 1944.  
 LIBBY, WALTER: *The History of Medicine*.  
 MACEWAN, SIR WILLIAM: *Pyogenic Diseases of the Brain and Spinal Cord*.  
 MARSHALL, ROBERT: *The Book of Belfast*.  
 Montreal Neurological Institute Foundation Volume: Neurological Biographies  
     and Addresses.  
 PARRY, T. WILSON: *Collected Papers on Prehistoric Trephination*.

- POTT, PERCIVAL : *Injuries to which the Head is Liable*  
 POWER, SIR D'ARCY : "The First Localized Cerebral Tumour," *Brit. Jour. of Surg.*,  
 vol. 19, No. 76, April, 1932.  
*Selections from The Papers and Speeches of John Chalmers DaCosta*, W. B.  
 Saunders Company, 1931.  
 SINGER, CHARLES : *A Short History of Medicine*.  
 SYMONDS, SIR CHARTERS J. : "Astley Paston Cooper," *Guy's Hospital Reports*,  
 vol. 90, 1940-41.  
 WALKER, RICHARD : *Memoirs of Medicine*, 1799.  
 WHITWELL, J. R. : *Historical Notes on Psychiatry*.

## REVIEW

MODERN MANAGEMENT IN CLINICAL MEDICINE. By F. Kenneth Albrecht, M.D. Pp. 1,238. London : Baillière, Tindall & Cox. 55s.

IN more senses than one, this book is a weighty contribution to our knowledge of American Medicine : it weighs five pounds. Published in London, this English edition is printed in America and is a beautiful example of the arts of printing and book production. Not everyone will like the arrangement of the pages in double columns, but it enables more matter to be presented in the space. The coloured plates are uniformly excellent and the diagrams almost invariably helpful. One feature which will strike the British reader is the bibliography at the end of each section, and one is afraid that it will make him wonder whether this book is a product of American "isolationism." There are, in all, 763 references to literature, of which 13 are to British medical literature. On this short list A. F. Hurst and P. Manson-Bahr score two each. T. Lewis and R. T. Grant share three, and there are references to the American publications of Robert Jones and "Watson-Jones"; the other British references are to less important sources. In the section on nervous and mental diseases there is a textual mention of the Gordon-Holmes (sic) rebound phenomenon, but no bibliographical references to any British neurologist. Alexander Fleming is credited with having discovered penicillin, but the reader is not referred to any British source among the fifty references which conclude the section on chemotherapy. (It is of minor importance that our author does not use the British titles of honour which these distinguished doctors have had conferred upon them.)

Although the book seems to depend on American sources, the British reader will find much that is familiar British teaching, much that is new and refreshing, and some statements which are a little surprising, as when he reads that in myxoedema "electro-cardiographic examination may reveal an inversion of T<sub>1</sub> . . . said to be almost pathognomonic of hypothyroidism." He will perhaps regret that Dr. Albrecht is either unfamiliar with, or has thought unworthy of inclusion, many recent advances in medicine, including, for example, the notable work of William Evans and his colleagues on the care and management of cardiac patients.

In spite of these criticisms, this is a most interesting and valuable book. Dr. Albrecht's opening words in his preface are that "this volume is intended for the doctor's office, not his library"; its admirable arrangement renders ready reference easy, but the numbered lists of symptoms, physical signs, and lines of treatment will commend themselves not only to the practising doctor, but also to those who are reading for examinations. His frequent use of tabular statements of comparison or contrast will remind old Queensmen of our own Professor Lindsay's teaching methods.

Perhaps the best section is that on diseases of the respiratory system, which is not surprising, as Dr. Albrecht is Consultant in Tuberculosis to the State of Kansas. Here a new type of pneumothorax apparatus (the Singer) is described; it appears to be an excellent one, and its sturdy construction renders it portable without anxiety. Two notable features of the book are the chapters on case-taking, which leaves nothing unsaid, and on the case of the ambulatory patient, with detailed instructions to those suffering from various diseases. There is also a helpful chapter, contributed by Dr. Seward E. Miller, on clinical laboratory medicine.

R. M.